CAN-Control-CPU

Hardware Manual

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Changes in the Chapters

The changes in the user's manual listed below affect changes in the **hardware**, as well as changes in the **description** of the facts only.

Manual rev.	Chapter	Changes with respect to previous revision
1.1	-	Connector names have been changed according to front panel text.
1.2	-	Pin numbers of plug-in connectors added.
1.3	1.2.5	Digital input thresholds corrected
	1.2.9	New A/D-converter AD7856 (14 bits resolution) introduced.
	2.2	Circuit parameters of digital inputs have changed.
	2.3	Circuit of GATE and PULSE input introduced.
	2.5	Circuit parameters of analog inputs have changed.
	2.6	Circuit parameters of analog outputs have changed.

Further technical changes are subject to change without notice.

N O T E

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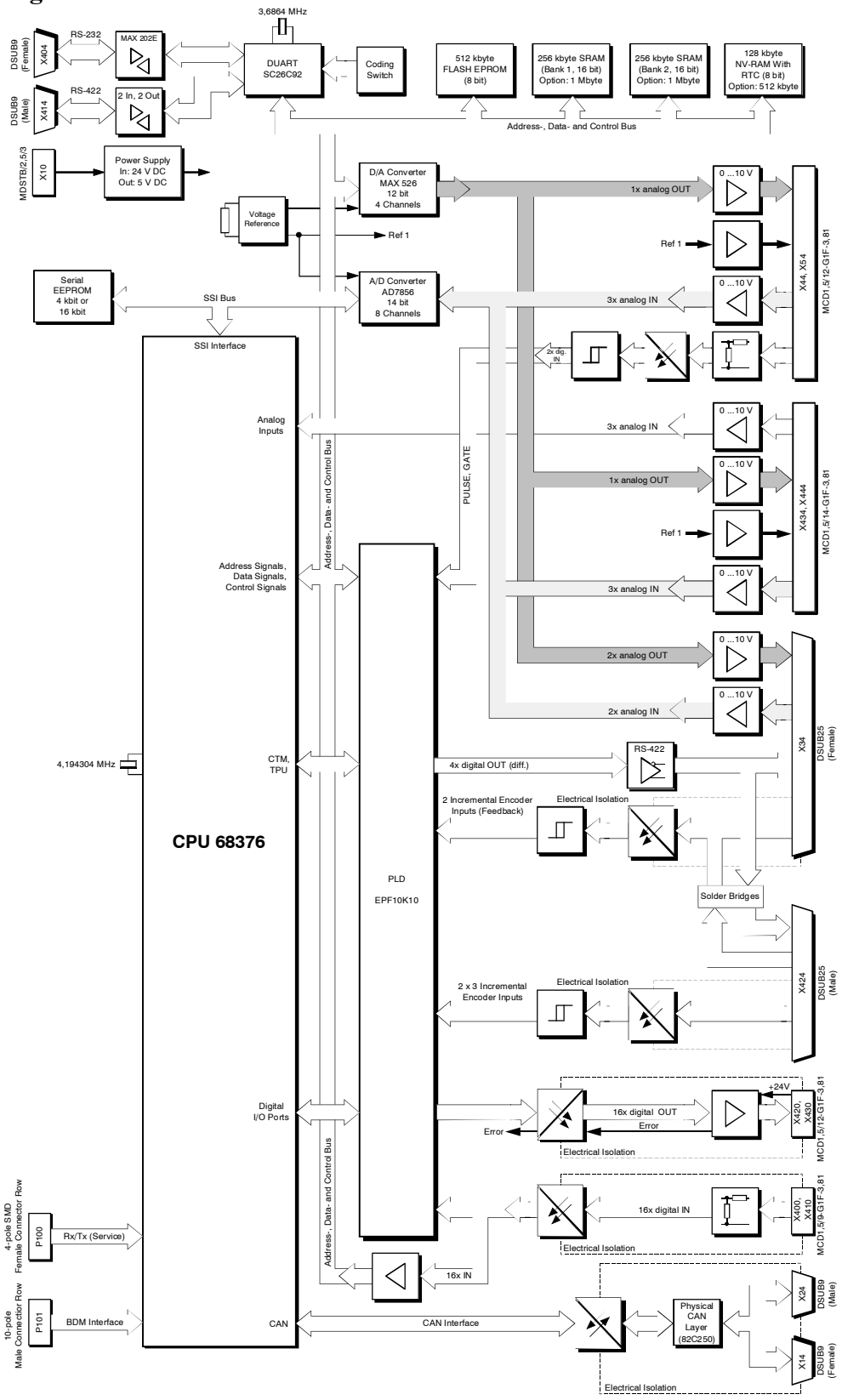
1. Technical Data

1.1 Block Diagram



1.2 Summary of the Technical Data

1.2.1 General Technical Data

Temperature range	permissible ambient temperature: 0...50 ˚C
Humidity	max. 90%, not condensing
Operating voltage	nominal voltage 18 V...30 VDC power consumption (typical, at 20 ˚C): approx. 5 W, electronical reverse battery protection safety fuse 400 mA/T
Connectors	X10 (MDSTB/2,5/3-GF-5,08) - power supply X14 (DSUB9/female) - CAN bus interface X24 (DSUB9/male) - CAN bus interface X34 (DSUB25/male) - laser I/O X44, X54 (MCD 1,5/12-G1F-3,81) - external interface X404 (DSUB9/female) - RS-232 interface X400, X410 (MCD 1,5/9-G1F-3,81) - digital inputs I0...I15 X414 (DSUB9/male) - RS-422 interface X420, X430 (MCD 1,5/12-G1F-3,81) - digital outputs Q0...Q15 X424 (DSUB25/female) - incremental encoder inputs X434, X444 (MCD 1,5/14-G1F-3,81) - external interface P100 (4-pole SMD female) - Rx/Tx service interface P101 (10-pole plug-in connector) - BDM interface P130 (8-pole plug-in connector) - ISP interface
Case	PCB dimension: 152.4 mm x 400 mm case dimension: 19” x 1U x 240 mm all connectors and switches are front accessible
Weight	ca. 550 g

Table 1.2.1: General data of the module

1.2.2 Microprocessor Circuits

CPU	microcontroller MC68376
Flash EPROM	memory size: 512 kbyte data bus wide: 8 bit circuit organisation: 1x 512 k (8 bit) circuit type: 29F040 access time: 70 ns
SRAM bank 1	memory size: 256 kbyte (optional 1 Mbyte) data bus wide: 16 bit circuits: 2x 128 k x 8 bit (2x 512 k x 8 bit) access time: 25 ns / 70 ns
SRAM bank 2	memory size: 256 kbyte (optional 1 Mbyte) data bus wide: 16 bit circuit organisation: 2x 128 k x 8 bit (2x 512 k x 8 bit) access time: 25 ns / 70 ns
NV-RAM / RTC	memory size: 128 kbyte (optional 512 kbyte) data bus wide: 8 bit circuit type: DS1646LP or DS1647LP circuit case: PLCC68
Serial EEPROM	memory size: 4 kbit (optional 16 kbit)

Table 1.2.2: Technical data of the microcontroller circuits

1.2.3 Serial Interfaces

Controller	SC26C92
Interface 1	RS-232, driver MAX 243, bit rate max. 38.4 kbit/s, connector DSUB9, female
Interface 2	RS-422, driver with 2 outputs and 2 inputs, bit rate is limited by the controller, connector DSUB9, male

Table 1.2.3: Technical data of the serial interfaces

1.2.4 CAN Controller Circuits

CAN Interface	physical layer according to ISO 11898
Transmission rate	selectable via jumpers or programmable up to 1 Mbit/s
CAN Identifier	programmable
µController	68376 (internal)
Electrical isolation	interface is electrically isolated from the controller and the other I/O circuits by optocouplers and DC/DC converters

Table 1.2.4: Technical data of the CAN- and µcontroller circuits

1.2.5 Digital Inputs I0...I15

Number	16 in groups with 8 inputs each
Input circuit	refer page 17, 18
Input voltages	input voltage range: max. permissible: $-30\ V \le U_{IN} \le 33\ V$ switching threshold input = '0': $U_{IN} < 14\ V$ switching threshold input = '1': $U_{IN} > 18\ V$
Input current	input = '1': I_{ON} = approx.. 10 mA (typical, at 30 V)
Electrical isolation	electrical isolation by optocouplers, each 8 inputs use one common GND
Filter	option: RC with $\tau_{on[24V]} \approx 500\mu s$

Table 1.2.5: Input specification I0...I15

1.2.6 GATE and PULSE Input

Number	2
Input voltage	nominal values GATE: 5 V, 15 V, 24 V nominal values PULSE: 5 V, 15 V switching threshold (input = '1') and maximum input voltage: 5 V: $U_{ON} \geq 3$ V $U_{MAX} = 8$ V 15 V: $U_{ON} \geq 8$ V $U_{MAX} = 18$ V 24 V: $U_{ON} \geq 18$ V $U_{MAX} = 30$ V The optocoupler circuit is followed by a Schmitt trigger circuit.
Input current	input = '1': I_{ON} = tbd.
Electrical isolation	the input circuit is electrically isolated from the microcontroller and the other I/O circuits by optocouplers

Table 1.2.6: Input specification of the GATE and PULSE input

1.2.7 Digital Outputs

Number	16 (in groups with 4 outputs each)
Output circuit	refer to page 20
Driver	L6376 4 outputs/circuit
Supply voltage	maximum voltage rating: U_{VCC} = 9.5 VDC...35 VDC
Load	current/channel (24 V): 0,65 A ... 1.2 A (50 ˚C)
Protection circuit	short circuit protection, overload (thermal)
Status messages	message in case of error (low supply voltage (U_{VCC} < 5V), over current, over temperature)
Timing	U_{VCC} = 24 V, R_L = 47 Ω: rising edge: 3 V ...7 V/µs falling edge: 4 V ... 10 V /µs
Electrical isolation	the input circuit is electrically isolated from the microcontroller and the other I/O circuits by optocouplers

Table 1.2.7: Output specification

1.2.8 Differential Digital Outputs

Number	3
Driver circuit	RS-422 driver
Control	via PLD
Power supply	local 5 V
Electrical isolation	no

Table 1.2.8: Specification of the digital outputs

1.2.9 Analog Inputs

Voltage Reference REF 195	
Error	Initial Error = 1 %, adjustment < 0,1%
Adjustment	by trimming resistor

Internal A/D Converter Of Controller 68376	
No. of channels	3 channels used
Resolution of converter	10 bit
Measuring range	0... 10 V via Shunt (can be activated by a wire bridge at the connector plug) 0...20 mA
Error	absolute error = ±20 mV on converter input voltage of 5 V
Conversion time	$T_{convert} \geq 10\ \mu s$ / channel
Input amplifier	instrumentation amplifier INA117, over voltage protection ±500 V (static)
Electrical isolation	no

A/D Converter AD7856	
Channel No.	8
Resolution of converter	14 Bit
Measuring range	0... 10 V via Shunt (can be activated by a wire bridge at the connector plug) 0...20 mA
Error	Offset Error = ± 5 LSB
Adjustment	adjustment can be done in the A/D converter by software
Conversion time	$T_{convert} \geq 5\ \mu s$ / channel
Input amplifier	instrumentation amplifier INA117, over voltage protection ±500 V (static)
Electrical isolation	no

Table 1.2.9: Specification of analog inputs

1.2.10 Analog Outputs

Number	4
Converter	MAX 526
Resolution	resolution of converter: 12 bit
Output voltage	0... 10 V $I_{OUTMAX} \geq 20$ mA
Error	offset error = ± 4 LSB gain error = ± 1 LSB (+initial error of the voltage reference MAX6160)
Settling time	$T_{OUT} \leq 5$ µs
Electrical isolation	no

Table 1.2.10: Specification of analog outputs

1.2.11 Incremental Encoder Interfaces

Number	2 (each with two encoder inputs and one index input, + 2 feedback inputs = 8 digital inputs)
Interface	differential
Input Parameter	U_{NENN} = 5 V R_I = 182 Ω I_{TYP} = 10 mA
Input circuit	2-wire connection, via optocoupler, electrically isolated (the following Schmitt trigger is inverting the input signal)
Electrical isolation	the input circuit is electrically isolated from the microcontroller and the other I/O circuits by optocouplers

Table 1.2.11: Specification of the encoder interfaces

1.2.12 LED Display

Display function	Marking	Colour
CAN status LED 1	1	red
CAN status LED 2	2	green
Digital out error	3	red
System OK	4	green

Table 1.2.12: LED display

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1.3 Order Information

Type	Properties	Order-No.
CAN-Control-CPU	CPU 68376, 512 kbyte Flash, 256 kbyte FAST RAM, 1 Mbyte SRAM, 4 kbit EEPROM, 128 kbyte NVRAM, RTC	C.2070.01
CAN-Control-CPU-RTOS-UH	RTOS-UH runtime licence	C.2070.10
CAN-Control-CPU-ME (*)	English users manual	C.2070.21

(*) If ordered together with the module, the manual will be delivered free of charge.

Table 1.3.1: Order information

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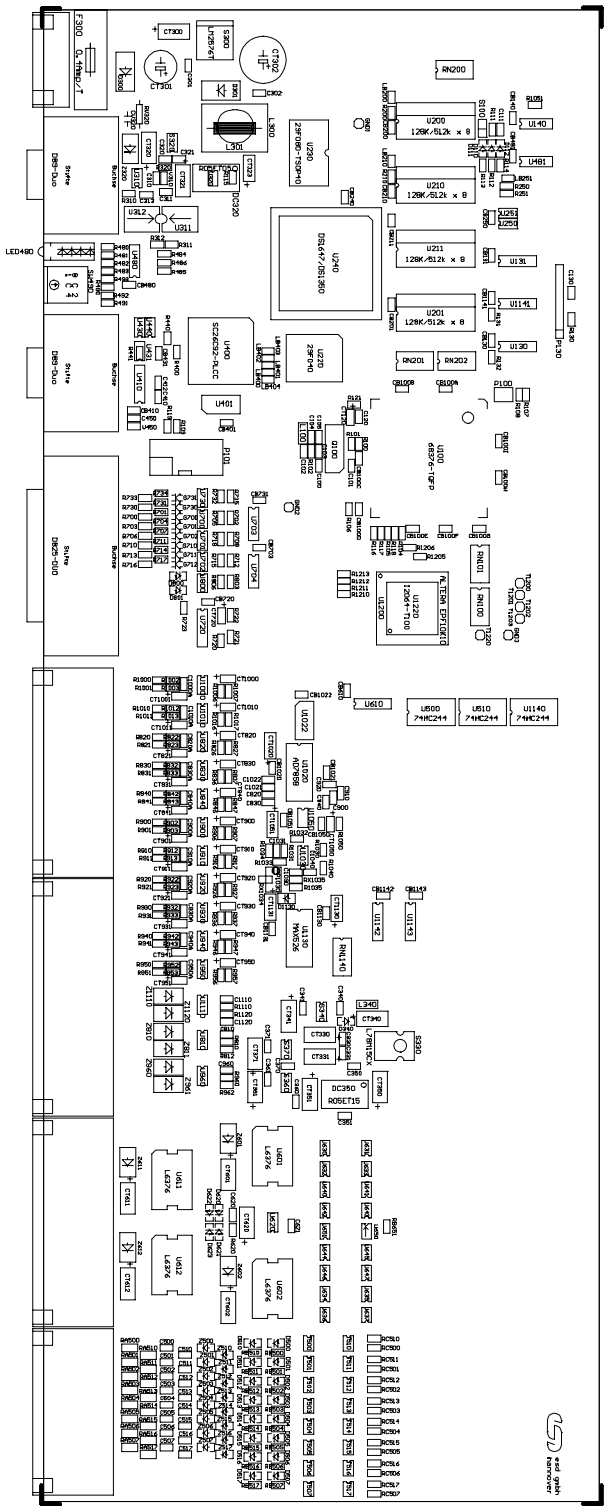
2. Description of the Units

2.1 PCB View



2.2 Digital Inputs I0...I15

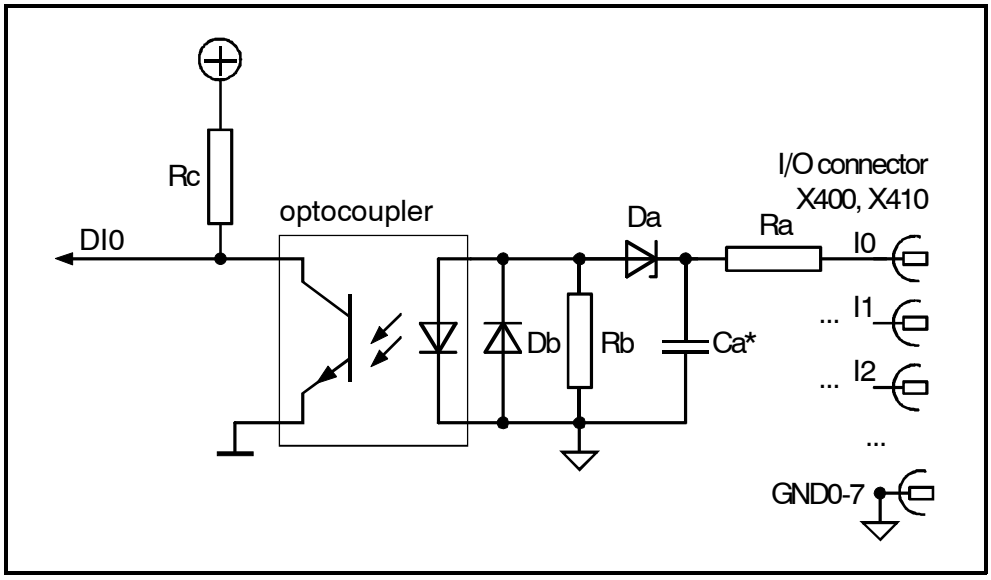


Fig. 2.2.1: Circuit of digital inputs (example: channel 0...7)

The capacitor Ca* can be equipped as an option.

Circuit parameters:
Ra = 2.2 kΩ
Rb = 1.0 kΩ
Rc = 4.7 kΩ
Ca = 100 nF
Da = ZMM11
Db = LL4148
Optocoupler = TLP181

2.3 GATE and PULSE Inputs

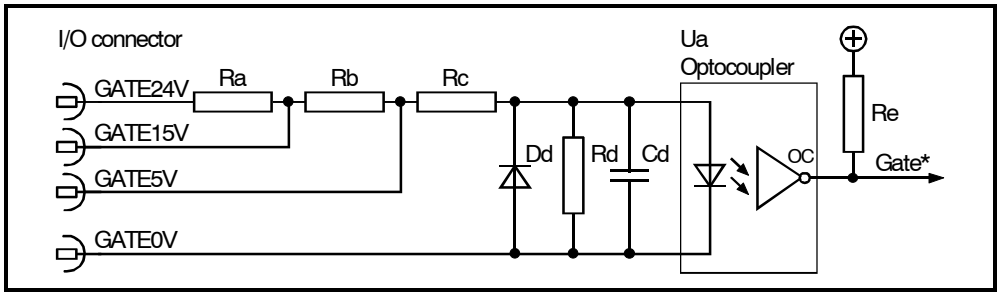


Fig. 2.3.1: Circuit of the GATE input

Circuit parameters:
Ra = 1 kΩ
Rb = 680 Ω
Rc = 270 Ω
Rd = 680 Ω
Re = 1 kΩ
Dd = LL4148
Cd = **220** nF
Ua = HCPL0631

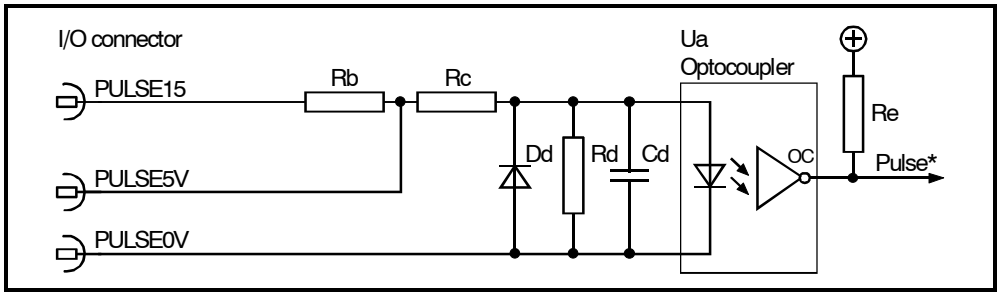


Fig. 2.3.2: Circuit of the PULSE input

Circuit parameters:
Rb = 680 Ω
Rc = 270 Ω
Rd = 680 Ω
Re = 1 kΩ
Dd = LL4148
Cd = **22** nF
Ua = HCPL0631

2.4 Digital Outputs

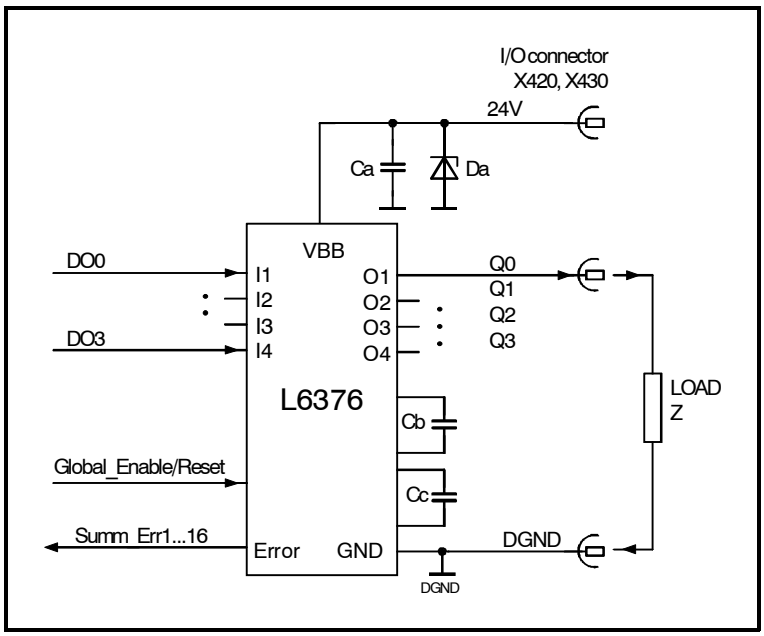


Fig. 2.4.1: Circuit of the digital outputs

Circuit parameters:
Protection diode Da:
Uz = SM6T33A [33 V (max. 50 V)]

2.5 Analog Inputs

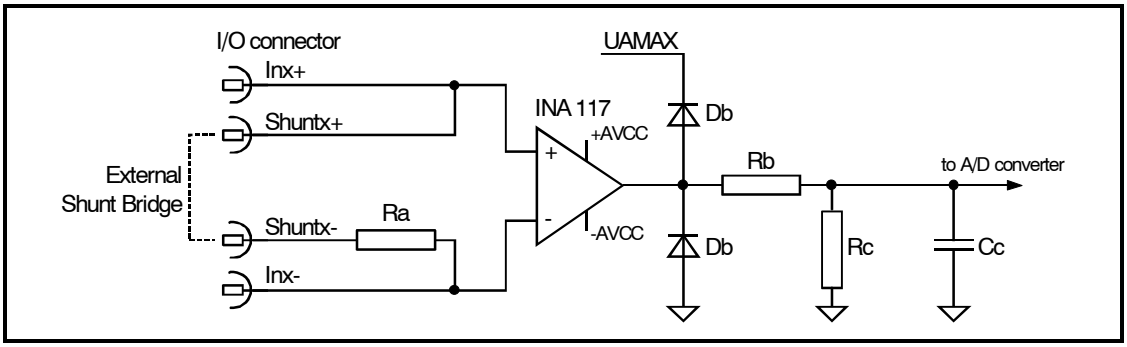


Fig. 2.5.1: Circuit of the analog inputs

Signal Names:
Inx+ : EXTANx+, LD_Aiy+
Inx- : EXTANx-, LD_Aiy-
x = 1, 2, ... 8
y = 1, 2

Circuit parameters:
Ra = 500 Ω / 0,1%
Rb = Rc = 1.0 kΩ / 0,1%
Cc = 1 nF
Db = BAR43S

+AVCC = +15 V
- AVCC = - 12 V

2.6 Analog Outputs

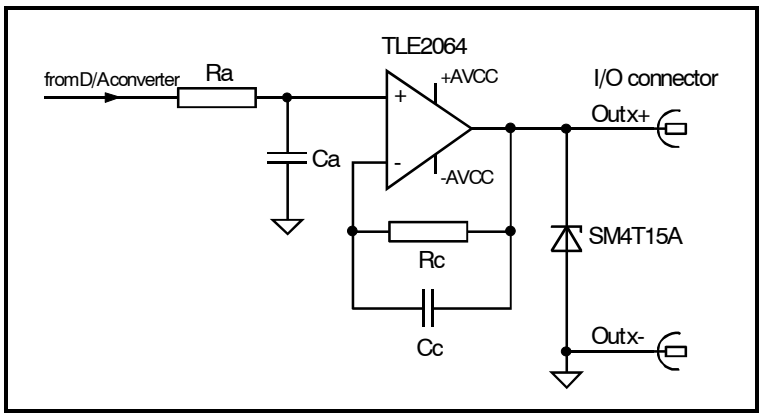


Fig. 2.6.1: Circuit of the analog outputs

Signal Names:
Outx+ : EXTANOUTx+, LD_Aqy+
Outx- : EXTANOUTx-, LD_Aqy-
x = 1, 2
y = 0, 1

Circuit parameters:
Amplifier V = 1

Ra = 10 kΩ / 1%
Rc = 10 kΩ / 1%
Ca = 100 pF
Cc = 100 pF

+AVCC = +15 V
- AVCC = - 12 V

2.7 Reference Voltage Outputs

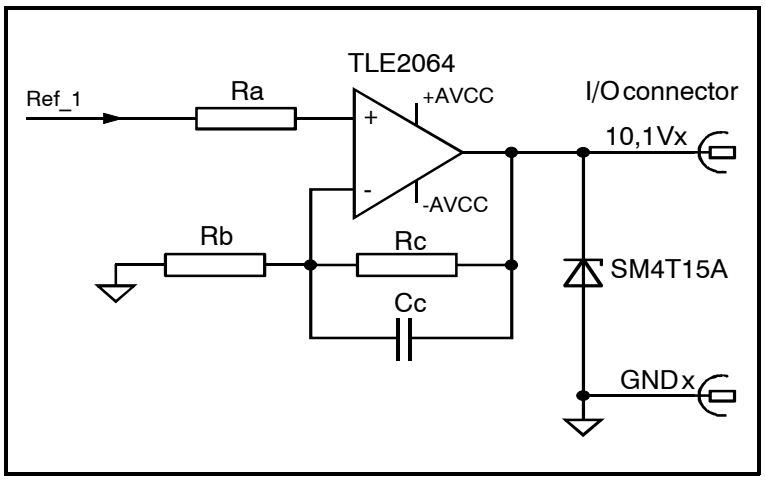


Fig. 2.7.1: Circuit of the reference voltage outputs

Signal Names:
x = 1, 2

Circuit parameters:
Ra = 10 kΩ
Rb = 1 MΩ
Rc = 10 kΩ
Cc = 1 nF

+AVCC = +15 V
- AVCC = - 12 V

2.8 CAN Interface

The physical CAN interface matches ISO 11898. The signals of the interface are electrically isolated from the CPU. For easier wiring the interface is equipped with two CAN connectors: a male and a female DSUB9-connector. The connectors have the same pin assignment.

As an option the local CAN interface can be supplied by the CAN signal CAN_V+ from the CAN bus. The power supply must be in the following range:

CAN_V+ = +8 V ...+13 V

(The power can be supplied e.g. from the esd CAN-Control I/O module.)

The following figure shows the principle wiring between the local CAN connectors at the CAN-Control-CPU board:

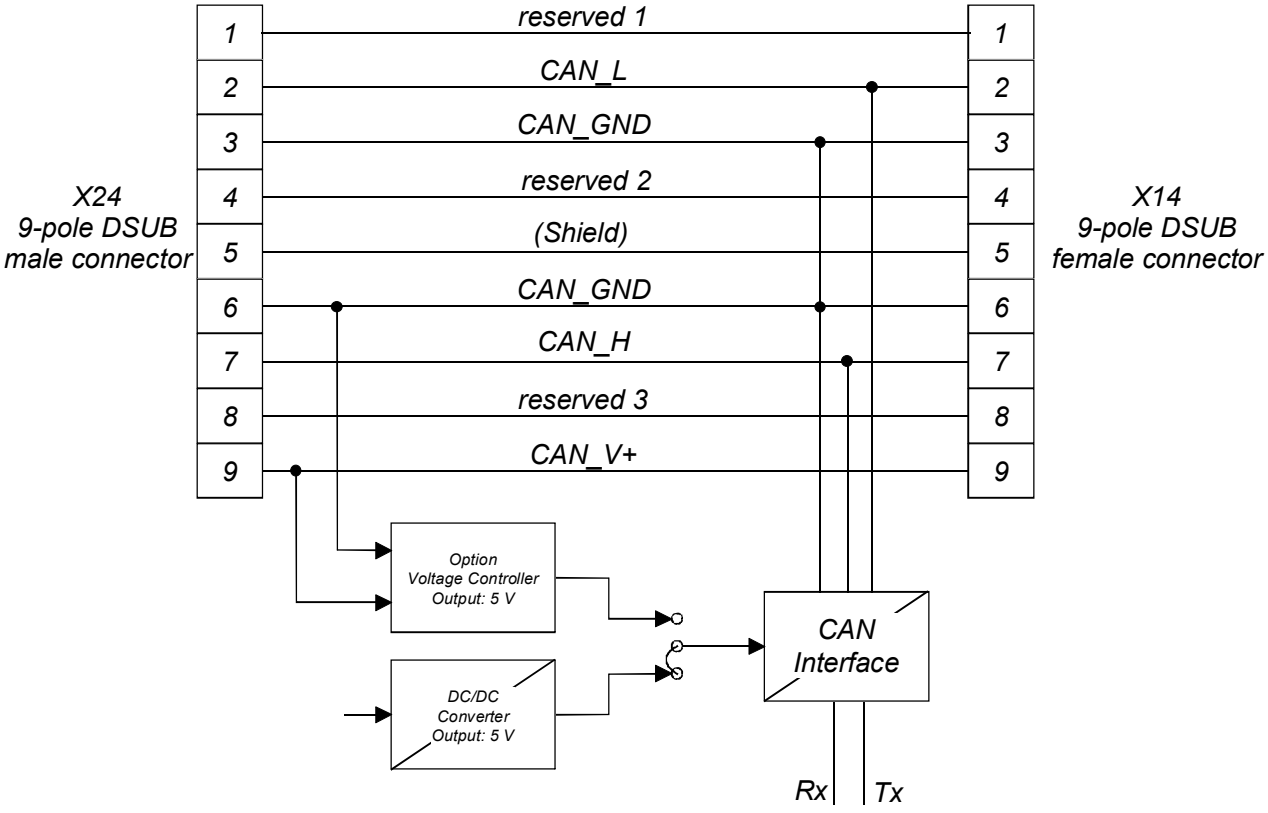
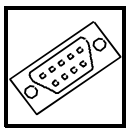


Fig. 2.8.1: Wiring between the two local CAN connectors and local power supply circuit



3. Appendix

3.1 Connector Pin Assignments

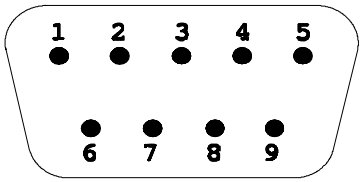
3.1.1 Power Supply Connector X10 (MSTB 2,5/3-GF-5,08)

Pin	Signal
1	GND
2	+24 V
3	GND

MSTB 2,5/3-GF-5,08

3.1.2 CAN Connector X24 (9-pole DSUB Male)

Pin Location :



Pin Assignment:

Signal	Pin		Signal
		1	reserved 1
CAN_GND	6		
		2	CAN_L
CAN_H	7		
		3	CAN_GND
reserved 3	8		
		4	reserved 2
CAN_V+	9		
		5	(Shield)

9-pole DSUB female

Signal Description:

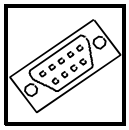
CAN_L, CAN_H ... CAN signals

CAN_GND ... reference GND of the physical layer

CAN_V+ ... Option: supply voltage output for external CAN interfaces

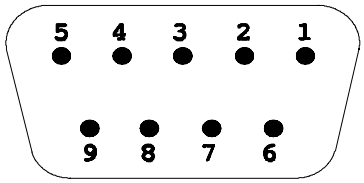
(Shield) ... pin for wiring the connectors shields

reserved x ... pins, that are reserved for future use. Pins with the same name at X14 and X24 are connected.



3.1.3 CAN Connector X14 (9-pole DSUB Female)

Pin Location :



Pin Assignment:

Signal	Pin		Signal
reserved 1	1	6	CAN_GND
CAN_L	2	7	CAN_H
CAN_GND	3	8	reserved 3
reserved 2	4	9	CAN_V+
(Shield)	5		

9-pole DSUB female

Signal Description:

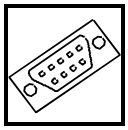
CAN_L, CAN_H ... CAN signals

CAN_GND ... reference GND of the physical layer

CAN_V+ ... Option: supply voltage output for external CAN interfaces

(Shield) ... pin for wiring the connectors shields

reserved x ... pins, that are reserved for future use. Pins with the same name at X14 and X24 are connected.



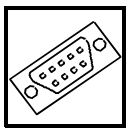
3.1.4 RS-232 Connector X404 (9-pole DSUB Female)

The reference for the data direction definition is the CAN-Control-CPU module.
The reference for the signal name definition is the PC (terminal, DTE).

The shield signal can be connected to GND or protection earth (via case) by a soldering bridge at the PCB.

Signal		Pin		Signal	
Shield		1	6	-	
RxD	output	2	7	-	
TxD	input	3	8	CTS	output
DTR	input	4	9	-	
GND	-	5			

9-pole DSUB female

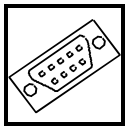


3.1.5 RS-422 Connector X414 (9-pole DSUB Male)

The reference for the data direction definition is the CAN-Control-CPU module.
The reference for the signal name definition is the PC (terminal, DTE).

Signal	Pin		Signal
		1	Shield = GND
Tx- output -	6	2	Tx+ output +
RTS- output -	7	3	RTS+ output +
Rx- input -	8	4	Rx+ input +
CTS- input -	9	5	CTS+ input +

9-pole DSUB connector



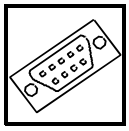
3.1.6 Laser Interface at X34 (25-pole DSUB Female)

Signal	Pin		Signal
LD_EN1+	1	14	LD_EN1-
LD_EN2+	2	15	LD_EN2-
LD_EN3+	3	16	LD_EN3-
LD_EN4+	4	17	LD_EN4-
FB1+	5	18	FB1-
FB2+	6	19	FB2-
LD_GND	7	20	LD_Aq0-
LD_Aq0+	8	21	LD_Aq1-
LD_Aq1+	9	22	LD_Ai0-
LD_Ai0+	10	23	LD_Ai1-
LD_Ai1+	11	24	LD_Ai0+
LD_Ai1+	12	25	Shunt_Ai1-
Shunt_Ai1-	13		

25-pole DSUB female

Signal Description:

LD_ENx-, LD_ENx+	digital differential outputs (x= 1, 2, 3,4)
LD_Aqy+, LD_Aqy-	analog output signals (y = 0,1)
LD_Aiy+, LD_Aiy-	analog input signals (y = 0,1)
Shunt_Ai1+, Shunt_Ai1-	bridges for shunt activation
LD_GND	reference GND of the two analog inputs
FBz-, FBz+	digital inputs (z = 1,2)



3.1.7 Incremental Encoder Interface at X424 (25-pole DSUB Connector)

Signal	Pin		Signal
		1	LD_EN11+
LD_EN11-	14	2	LD_EN12+
LD_EN12-	15	3	LD_EN13+
LD_EN13-	16	4	LD_EN14+
LD_EN14-	17	5	FB11+
FB11-	18	6	FB12+
FB12-	19	7	S02+
S02-	20	8	S01+
S01-	21	9	S00+
S00-	22	10	S12+
S12-	23	11	S11+
S11-	24	12	S10+
S10-	25	13	-

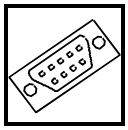
25-pole DSUB connector

Signal Description:

S00+ S00-	home signal	of axle 1
S01+ S01-	encoder input A	of axle 1
S02+ S02-	encoder input B	of axle 1
S10+ S10-	home signal	of axle 2
S11+ S11-	encoder input A	of axle 2
S12+ S12-	encoder input B	of axle 2

LD_EN1x-, LD_EN1x+ digital differential outputs (x= 1, 2, 3, 4)
(only, if solder bridges are closed)

FB1z-, FB1z+ digital inputs (z = 1,2)
(only, if solder bridges are closed)



Connector Pin Assignment

3.1.8 External Interface at X434 and X444 (MCD 1,5/14-G1F-3,81)

X444

upper	Pin *1)	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Pin *2)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
row	Signal	EXT AN7+	Shunt 7+	Shunt 7-	EXT AN7-	EXT AN8+	Shunt 8+	Shunt 8-	EXT AN8-	EXT AN9+	Shunt 9+	Shunt 9-	EXT AN9-	EXTAN OUT2+	EXTAN OUT2-

X434

lower	Pin	1	2	3	4	5	6	7	8	9	10	11	12	13	14
row	Signal	EXT AN4+	Shunt 4+	Shunt 4-	EXT AN4-	EXT AN5+	Shunt 5+	Shunt 5-	EXT AN5-	EXT AN6+	Shunt 6+	Shunt 6-	EXT AN6-	10,1V2 (Ref)	GND2

MCD 1,5/14-G1F-3,81

1*) Pin numbers used in schematic diagrams.
2*) Pin numbers used for labeling plug-in connectors.

3.1.9 External Interface at X44 and X54 (MCD 1,5/12-G1F-3,81)

X54

upper	Pin 1*)	13	14	15	16	17	18	19	20	21	22	23	24
	Pin 2*)	1	2	3	4	5	6	7	8	9	10	11	12
row	Signal	EXT AN1+	Shunt 1+	Shunt 1-	EXT AN1-	EXT AN2+	Shunt 2+	Shunt 2-	EXT AN2-	EXT AN3+	Shunt 3+	Shunt 3-	EXT AN3-

X44

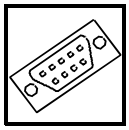
lower	Pin	1	2	3	4	5	6	7	8	9	10	11	12
row	Signal	GATE 24V	GATE 15V	GATE 5V	GATE 0V	PULSE 15V	PULSE 5V	PULSE 0V	GND1	EXTAN OUT1+	EXTAN OUT1-	10,1V1	GND1

MCD 1,5/12-G1F-3,81

1*) Pin numbers used in schematic diagrams.
2*) Pin numbers used for labeling plug-in connectors.

Signal Description:

GATExV, GATE0V	digital gate input with reference signal (x= 5V, 15V, 24V)
PULSEyV, PULSE0V	digital pulse input with reference signal (y= 5V, 15V)
EXTANOUTz+, EXTANOUTz-	analog outputs (z = 1, 2)
10,1Vz, GNDz	reference voltage and reference GND for analog outputs
EXTANu+, EXTANu-	analog input (u = 1, 2, ...9)
Shuntu+, Shuntu-	if these contacts are shorted, the shunt is activated



3.1.10 Digital Outputs at X420 and X430 (MCD 1,5/12-G1F-3,81)

The connector is equipped with two screwing blocks, each for one output group.

X430

upper	Pin 1*)	13	14	15	16	17	18	19	20	21	22	23	24
	Pin 2*)	1	2	3	4	5	6	7	8	9	10	11	12
row	Signal	+24V Q8-11	Q8	Q9	Q10	Q11	GND Q8-11	+24V Q12-15	Q12	Q13	Q14	Q15	GND Q12-15

X420

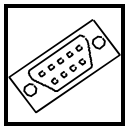
lower	Pin	1	2	3	4	5	6	7	8	9	10	11	12
row	Signal	+24V Q0-3	Q0	Q1	Q2	Q3	GND Q0-3	+24V Q4-7	Q4	Q5	Q6	Q7	GND Q4-7

MCD 1,5/12-G1F-3,81

1*) Pin numbers used in schematic diagrams.

2*) Pin numbers used for labeling plug-in connectors.

All GND signals of the digital outputs are shorted at the PCB. One circuit is supplied by one +24V-supply pin.



Connector Pin Assignment

3.1.11 Digital Inputs at X400 and X410 (MCD 1,5/9-G1F-3,81)

X410

upper row

Pin 1*)	10	11	12	13	14	15	16	17	18
Pin 2*)	1	2	3	4	5	6	7	8	9
Signal	I8	I9	I10	I11	I12	I13	I14	I15	GND 8-15

X400

lower row

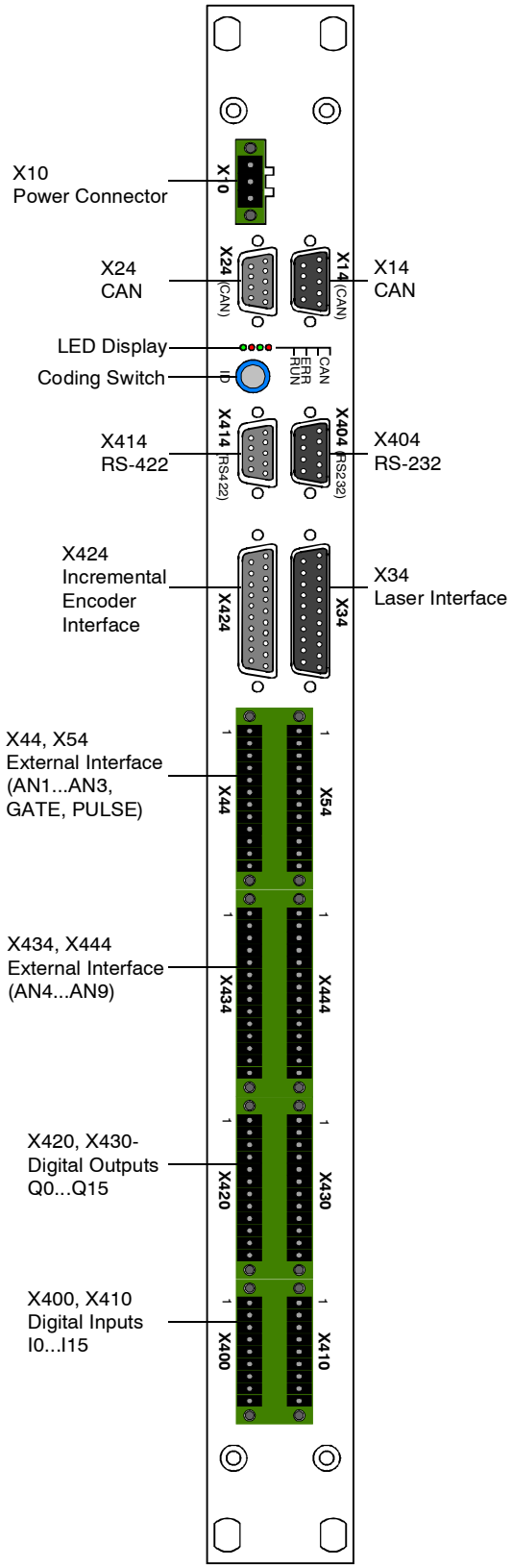
Pin	1	2	3	4	5	6	7	8	9
Signal	I0	I1	I2	I3	I4	I5	I6	I7	GND 0-7

MCD 1,5/9-G1F-3,81

1*) Pin numbers used in schematic diagrams.

2*) Pin numbers used for labeling plug-in connectors.

3.2 Front Panel



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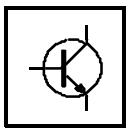

3.3 Circuit Diagrams

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